WE CLAIM:

1. A method of forming a continuous metal article of indefinite length, comprising the steps of:

providing a plurality of molten metal injectors each having an injector housing and a piston reciprocally operable within the housing, with the injectors each in fluid communication with a molten metal supply source and an outlet die, and with the piston of each of the injectors movable through a first stroke wherein molten metal is received into the respective housings from the molten metal supply source, and a second stroke wherein the injectors each provide molten metal to the outlet die under pressure, and wherein the outlet die is configured to cool and solidify the molten metal and form a continuous metal article of indefinite length;

serially actuating the injectors to move the respective pistons through their first and second strokes at different times to provide substantially constant molten metal flow rate and pressure to the outlet die;

cooling the molten metal in the outlet die to form semi-solid state metal;

solidifying the semi-solid state metal in the outlet die to form solidified metal having an as-cast structure; and

discharging the solidified metal through an outlet die aperture to form the metal article.

2. The method of claim 1, further including the step of working the solidified metal to generate a wrought structure in the solidified metal before the step of discharging the solidified metal through the die aperture.

3. The method of claim 2, wherein the step of working the solidified metal is performed in a divergent-convergent chamber located upstream of the die aperture.

4. The method of claim 2, wherein the outlet die includes an outlet die passage communicating with the die aperture for conveying the metal to the die aperture, with the die aperture defining a smaller cross sectional area than the die passage, and wherein the step of working the solidified metal is performed by discharging the solidified metal through the smaller cross section die aperture.

5. The method of claim 4, further comprising the step of discharging the solidified metal through a second outlet die defining a die aperture, with the second outlet die located downstream of the first outlet die.

6. The method of claim 5, wherein the second die aperture defines a smaller cross sectional area than the first die aperture, and wherein the method includes the step of further working the solidified metal to form the wrought structure by discharging the solidified metal through the second die aperture.

7. The method of claim 1, wherein the die aperture has a symmetrical cross section with respect to at least one axis passing threrethrough for forming a metal article having a symmetrical cross section.

8. The method of claim 1, wherein the die aperture is configured to form a circular shaped cross section metal article.

9. The method of claim 1, wherein the die aperture is configured to form a polygonal shaped cross section metal article.

10. The method of claim 1, wherein the die aperture is configured to form an annular shaped cross section metal article.

11. The method of claim 1, wherein the die aperture has an asymmetrical cross section for forming a metal article having an asymmetric cross section.

12. The method of claim 4, further including a plurality of rolls in contact with the formed metal article downstream of the die aperture, with the method further including the step of providing backpressure to the plurality of injectors through frictional contact between the rolls and metal article.

13. The method of claim 12, wherein the die aperture is configured to form a continuous plate.

14. The method of claim 13, wherein the method includes the step of further working the solidified metal forming the continuous plate with the rolls to generate the wrought structure.

15. The method of claim 2, wherein the outlet die includes an outlet die passage communicating with the die aperture for conveying the metal to the die aperture, with the die passage defining a smaller cross sectional area than the die aperture, and wherein the step of working the solidified metal is performed by discharging the solidified metal from the smaller cross section die passage into the larger cross section die aperture.

16. The method of claim 15, further including a plurality of rolls in contact with the formed metal article downstream of the die aperture, with the method

further including the step of providing backpressure to the plurality of injectors through frictional contact between the rolls and metal article.

17. The method of claim 16, wherein the die aperture is configured to form a continuous ingot.

18. The method of claim 17, wherein the method includes the step of further working the solidified metal forming the continuous ingot with the rolls to generate the wrought structure.

19. The method of claim 1, wherein the metal article is a solid rod having a polygonal shaped cross section.

20. The method of claim 1, wherein the metal article is a solid rod having a circular shaped cross section.

21. The method of claim 1, wherein the metal article is a circular shaped tube.

22. The method of claim 1, wherein the metal article is a polygonal shaped tube.

23. The method of claim 1, wherein the metal article is a plate having a polygonal shaped cross section.

24. The method of claim 1, wherein the metal article is an ingot having a polygonal shaped cross section.

25. The method of claim 1, wherein the metal article is an ingot having a circular shaped cross section.

26. A method of forming continuous metal articles of indefinite length, comprising the steps of:

providing a plurality of molten metal injectors each having an injector housing and a piston reciprocally operable within the housing, with the injectors each in fluid communication with a molten metal supply source and an outlet manifold, and with the piston of each of the injectors movable through a first stroke wherein molten metal is received into the respective housings from the molten metal supply source, and a second stroke wherein the injectors each provide molten metal to the outlet manifold under pressure, and wherein the outlet manifold includes a plurality of outlet dies for forming continuous metal articles of indefinite length, with the outlet dies configured to cool and solidify the molten metal to form the metal articles;

serially actuating the injectors to move the respective pistons through their first and second strokes at different times to provide substantially constant molten metal flow rate and pressure to the outlet manifold;

cooling the molten metal in the outlet dies to form semi-solid state metal in the respective outlet dies;

solidifying the semi-solid state metal in the outlet dies to form solidified metal having an as-cast structure; and

discharging the solidified metal through outlet die apertures defined by the respective outlet dies to form the metal articles.

27. The method of claim 26, further including the step of working the solidified metal in the outlet dies to generate a wrought structure in the solidified metal before the step of discharging the solidified metal through the die apertures.

28. The method of claim 27, wherein the step of working the solidified metal in the outlet dies is performed in a divergent-convergent chamber located upstream of the die aperture of each of the outlet dies.

29. The method of claim 27, wherein the outlet dies each include an outlet die passage communicating with the die aperture for conveying the metal to the die aperture, with the die aperture defining a smaller cross sectional area than the die passage, and wherein the step of working the solidified metal is performed by discharging the solidified metal through the smaller cross section die aperture of each of the outlet dies.

30. The method of claim 29, wherein at least one of the outlet dies has a die passage defining a smaller cross sectional area than the corresponding die aperture, and wherein the step of working the solidified metal in the at least one outlet die is performed by discharging the solidified metal from the smaller cross section die passage into the corresponding larger cross section die aperture.

31. The method of claim 27, further comprising the step of discharging the solidified metal of at least one of the metal articles through a second outlet die defining a die aperture, with the second outlet die located downstream of the first outlet die.

32. The method of claim 31, wherein the second die aperture defines a smaller cross sectional area than the first die aperture, and wherein the method includes

the step of further working the solidified metal of the at least one metal article to form the wrought structure by discharging the solidified metal through the second die aperture.

33. The method of claim 26, further including the step of working the solidified metal forming at least one of the metal articles to generate wrought structure in the at least one metal article, with the working step occurring downstream of the outlet dies.

34. The method of claim 33, wherein the working step is performed by a plurality of rolls in contact with the at least one metal article, with the at least one metal article including a continuous plate or continuous ingot.

35. The method of claim 26, wherein the die aperture of at least one of the outlet dies has a symmetrical cross section with respect to at least one axis passing threrethrough for forming a metal article having a symmetrical cross section.

36. The method of claim 26, wherein the die aperture of at least one of the outlet dies is configured to form a circular shaped cross section metal article.

37. The method of claim 26, wherein the die aperture of at least one of the outlet dies is configured to form a polygonal shaped cross section metal article.

38. The method of claim 26, wherein the die aperture of at least one of the outlet dies is configured to form an annular shaped cross section metal article.

39. The method of claim 26, wherein the die aperture of at least one of the outlet dies has an asymmetrical cross section for forming a metal article having an asymmetrical cross section.

40. The method of claim 26, wherein the die aperture of at least one of the outlet dies has a symmetrical cross section with respect to at least one axis passing

threrethrough for forming a metal article having a symmetrical cross section, and wherein the die aperture of at least one of the outlet dies has an asymmetrical cross section for forming a metal article having an asymmetrical cross section.

41. The method of claim 27, further including a plurality of rolls associated with each of the outlet dies and in contact with the formed metal articles downstream of the respective die apertures, and the method further includes the step of providing backpressure to the plurality of injectors through frictional contact between the rolls and metal articles.

42. The method of claim 41, wherein at least one of the die apertures is configured to form a continuous plate.

43. The method of claim 42, wherein the method includes the step of further working the solidified metal forming the continuous plate with the rolls to generate the wrought structure.

44. The method of claim 26, wherein the outlet dies each include an outlet die passage communicating with the die aperture for conveying the metal to the die aperture, wherein at least one of the outlet dies has a die passage defining a smaller cross sectional area than the corresponding die aperture, and wherein the method includes the step of working the solidified metal to generate wrought structure by discharging the solidified metal from the smaller cross section die passage into the corresponding larger cross section die aperture of the at least one outlet die.

45. The method of claim 44, wherein the larger cross section die aperture is configured to form a continuous ingot.

46. The method of claim 45, further including a plurality of rolls in contact with the ingot downstream of the at least one outlet die, with the method further including the step of providing backpressure to the plurality of injectors through frictional contact between the rolls and ingot.

47. The method of claim 46, wherein the method includes the step of further working the solidified metal forming the continuous ingot with the rolls to generate the wrought structure.

48. The method of claim 26, wherein at least one of the metal articles discharging from the outlet dies is a solid rod having a polygonal or circular shaped cross section.

49. The method of claim 26, wherein at least one of the metal articles discharging from the outlet dies is a circular shaped cross section or polygonal shaped cross section tube.

50. The method of claim 26, wherein at least one of the metal articles discharging from the outlet dies is a plate having a polygonal shaped cross section.

51. The method of claim 26, wherein at least one of the metal articles discharging from the outlet dies is an ingot having a polygonal shaped or circular shaped cross section.

52. An apparatus for forming continuous metal articles of indefinite length, comprising:

an outlet manifold configured for fluid communication with a source of molten metal; and

a plurality of outlet dies in fluid communication with the outlet manifold and configured to form a plurality of continuous metal articles of indefinite length, with the outlet dies each further comprising:

a die housing attached to the outlet manifold, with the die housing defining a die aperture configured to form the cross sectional shape of the continuous metal article exiting the outlet die, with the die housing defining a die passage in fluid communication with the outlet manifold for conveying metal to the die aperture, and with the die housing further defining a coolant chamber surrounding at least a portion of the die passage for cooling and solidifying molten metal received from the outlet manifold and passing through the die passage to the die aperture.

53. The apparatus of claim 52, wherein the die passage of at least one of the outlet dies defines a divergent-convergent located upstream of the corresponding die aperture.

54. The apparatus of claim 52, wherein the die passage of at least one of the outlet dies includes a mandrel positioned therein to form an annular shaped cross section metal article.

55. The apparatus of claim 52, further including a plurality of rolls associated with each of the outlet dies and positioned to contact the formed metal articles

downstream of the respective die apertures for frictionally engaging the metal articles and applying backpressure to the molten metal in the manifold.

56. The apparatus of claim 52, wherein at least one of the die passages of the outlet dies defines a larger cross sectional area than the cross sectional area defined by the corresponding die aperture.

57. The apparatus of claim 52, wherein at least one of the die passages of the outlet dies defines a smaller cross sectional area than the cross sectional area defined by the corresponding die aperture.

58. The apparatus of claim 52, wherein the die passage of at least one of the outlet dies defines a larger cross sectional area than the cross sectional area defined by the corresponding die aperture, and further including a second outlet die located downstream of the at least one outlet die, with the second outlet die defining a die aperture having a smaller cross sectional area than the corresponding upstream die aperture.

59. The apparatus of claim 58, wherein the second outlet die is fixedly attached to the upstream outlet die.

60. The apparatus of claim 52, wherein the die housing of each of the outlet dies is fixedly attached to the outlet manifold.

61. The apparatus of claim 52, wherein the die housing of each of the outlet dies is integrally formed with the outlet manifold.

62. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies is configured to form a circular shaped cross section metal article.

63. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies is configured to form a polygonal shaped cross section metal article.

64. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies is configured to form an annular shaped cross section metal article.

65. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies has an asymmetrical cross section for forming a metal article having an asymmetrical cross section.

66. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies has a symmetrical cross section with respect to at least one axis passing threrethrough for forming a metal article having a symmetrical cross section.

67. The apparatus of claim 66, wherein the die aperture of at least one of the outlet dies has an asymmetrical cross section for forming a metal article having an asymmetrical cross section

68. The apparatus of claim 52, wherein the die aperture of at least one of the outlet dies is configured to form a continuous plate or continuous ingot.

69. The apparatus of claim 52, wherein the continuous plate or continuous ingot has a polygonal shaped cross section.

70. The apparatus of claim 52, wherein the apparatus includes a single outlet die having a die housing defining a die aperture and a die passage in fluid communication with the outlet manifold, and further defining a coolant chamber at least partially surrounding the die passage, with the die aperture configured to form the cross sectional shape of the continuous metal article.